Description of the unknown female of *Agriopis beschkovi* Ganev, 1987 (Geometridae: Ennominae), and illustration of the larvae

Georg Petschenka [1], Majid Tavakoli [2] & Robert Trusch [1]

[1] Staatliches Museum für Naturkunde Karlsruhe, Erbprinzenstraße 13, 76133 Karlsruhe, Germany; e-mail: g.petschenka@smnk.de, trusch@smnk.de

[2] Lorestan Agricultural and Natural Resources Research Center Khorramabad, P.O. Box: 348, Iran; e-mail: majide322@yahoo.com

Abstract. We describe the unknown female of *Agriopis beschkovi* Ganev, 1987 (Geometridae, Ennominae), a species so far only reported from Bulgaria and Iran. The findings are based on material collected in oak forests of the West-Iranian provinces Lorestan and Kermanshah where *A. beschkovi* can cause calamities. Apart from the distinctive habitus the long antennal setae and morphological details of the genitalia are diagnostic features of the females. The female's genitalia and habitus, the reduced tympanal organ, male specimens, the male genitalia and the two colour forms of the hitherto unknown larvae are illustrated. Observations on the biology of *A. beschkovi* are given. The female genitalia of the related species *Agriopis leucophaearia*, *Agriopis aurantiaria*, *Agriopis marginaria* and *Agriopis bajaria* are illustrated for comparison.

Zusammenfassung. Wir beschreiben das unbekannte, flügellose Weibchen von *Agriopis beschkovi* (Geometridae, Ennominae), einer Art, die bislang nur aus Bulgarien und dem Iran bekannt ist. Die gewonnenen Ergebnisse basieren auf Material, das in Eichenwäldern der westiranischen Provinzen Lorestan und Kermanshah gesammelt wurde, wo *A. beschkovi* Kalamitäten verursacht. Neben dem unverwechselbaren Habitus des Weibchens stellen die langen Setae auf den Antennen und morphologische Details des Genitalorgans diagnostische Merkmale dar. Wir bilden das weibliche Genitalorgan sowie den Habitus und das reduzierte Tympanalorgan des Weibchens ab. Neben einem lebenden männlichen Exemplar zeigen wir die männlichen Genitalorgane und die beiden Farbvarianten der bislang nicht bekannten Larve. Die Arbeit enthält außerdem Angaben zur Biologie von *A. beschkovi*. Weiterhin zeigen wir die weiblichen Genitalorgane der verwandten Arten *Agriopis leucophaearia*, *Agriopis aurantiaria*, *Agriopis marginaria* und *Agriopis bajaria*.

Key words. Lepidoptera, Geometridae, Ennominae, *Agriopis*, apterous female, genitalia morphology, tympanal organ, winter moths, larvae, pest, Iran.

Introduction

Members of the genus *Agriopis* Hübner, 1825 (Scoble et al. 1999) are generally active during the cold season as it is well known for *A. leucophaearia* ([Denis & Schiffermüller], 1775), *A. aurantiaria* (Hübner, 1799), *A. bajaria* ([Denis & Schiffermüller], 1775), and *A. marginaria* (Fabricius, 1776). *A. beschkovi* Ganev, 1987 displays a similar activity pattern as indicated by the collection dates mentioned by Ganev (1987) and the dates of the material investigated here. The species was described by Ganev in 1987 on the basis of Bulgarian specimens. Until now the species has only been recorded from Bulgaria and Iran (Ganev 1987; Müller 1996; Hausmann pers. comm.). However, the female of *A. beschkovi* has remained unknown and is described here by external characters and genitalia morphology.

Material

The investigated specimens were reared from larvae collected in 2004 and 2005 in West-Iran (Lorestan: Ghelaie, Shor-abe, Evandar and Kermanshah: Gahvareh) by the

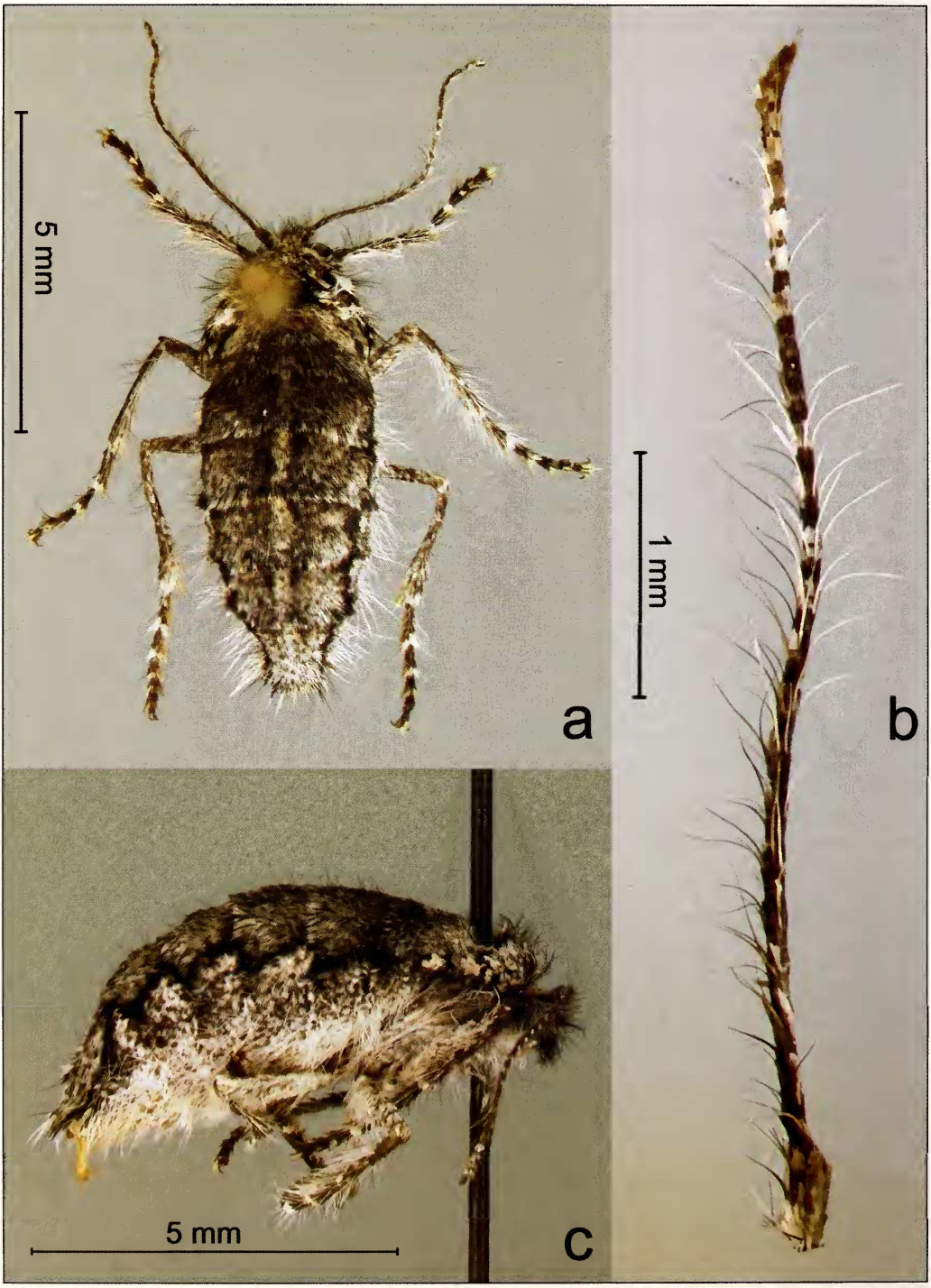

Fig. 1. Female of *Agriopis beschkovi* Ganev, 1987 from W-Iran, 2004-2005, ex larva, leg. M. Tavakoli; **a.** dorsal view of a female, **b.** right antenna of another specimen, **c.** lateral view of the female shown in picture a before mounting.

second author. The biological observations were also made at these locations. For the investigation of external characters four female specimens were used. The description of the female genitalia relies on further five specimens. The illustrated and dissected males were also reared from these larvae. In habitus (Fig. 3c, 4) and male genitalia (Fig. 5) we could not observe any noteworthy differences from the illustrations given in Ganev (1987). We compared the female genitalia of *A. beschkovi* with those of other *Agriopis* species. For this purpose we dissected the following material (citations as written on the labels): *A. leucophaearia*. 2♀♀ Austr. inf., Wien, Kahlenberg, 4.ii.1923., A. Ortner. *A. marginaria*. 1♀ Austria Inferior, W.-Wald 4.iv.1920, coll. H. Reisser, Wien; 1♀ Austria Inferior, Mauer 12.iii.1937, coll. H. Reisser, Wien; 1♀ Neubau-Kreuzstetten, Austr. Inf. 14.iv.1940, coll. H. Reisser, Wien. *A. aurantiaria*. 2♀♀ Austr. inf., Neuwaldegg, 2/11 1930, Ing. Kautz, Wien; 1♀ [Germany, Baden-Württemberg], Ettlingen, Stadtgeb., 22.xi.1956.; 1♀ Austr. inf., Wien, 3-markstein, 10.xi.1946, A. Ortner. *A. bajaria*. 1♀ E Larva, [Austria], Muellendorf, Burgenld 2.xi.1933, coll. H. Reisser. Wien; 1♀ E Larva, [Austria], Muellendorf, Burgenld 19.xi.1933, coll. H. Reisser. Wien; 2♀♀ [Germany, Bayern], Ingolstadt, el. 20.x.1959, Schlusche leg. The investigated material is deposited in the Staatliches Museum für Naturkunde Karlsruhe (SMNK); the images of figs. 1, 2, 5, 6 were taken with the automontage technology.

Description of the female

Habitus. The habitus of an *A. beschkovi* female is shown in Fig. 1 (a, c). Length (distance from frons to the tip of abdomen) ranges from 7 to 8.5 mm (n = 5).
Head. Proboscis present but strongly reduced, palps whitish. Vertex greyish, frons bearing a black tuft of long hair-like scales. Parts of the antennae chequered (annulated) dark and light, covered with long setae (Fig. 1b).
Thorax. Wings completely reduced, tegulae present. Legs with white femora; ventral side of tarsi light brown-coloured; apical scales of tibia and tarsomeres pale.
Pregenital abdomen. Dorsal side of abdomen grey with a light medial line; ventral side white, separated from the darker upperside by a pleural, black, zigzag line (Fig.1c). The tympanal organ of males seems to be regularly developed as it has a large tympanal cavity. In the females the tympanal organ is reduced to a conspicuous hook (Fig. 2c). The bulla tympani is largely reduced and only a small residue of the former cavity is present. Genitalia. Apophyses posteriores long and slender, proximal end curved and flattened, hockey-stick-shaped (Fig. 2). Apophyses anteriores about 60% length of apophyses posteriores, proximal end similarly flattened but less curved. Tergum A8 weakly sclerotized, lamella antevaginalis crescent-shaped. Posterior part of ductus bursae membranous and funnel-shaped. Anterior part of ductus bursae curved, long and slender, more strongly sclerotized and three to four times longer than the funnel-shaped posterior part (measured from the proximal border of lamella antevaginalis to origin of ductus seminalis and from origin of ductus seminalis to junction with corpus

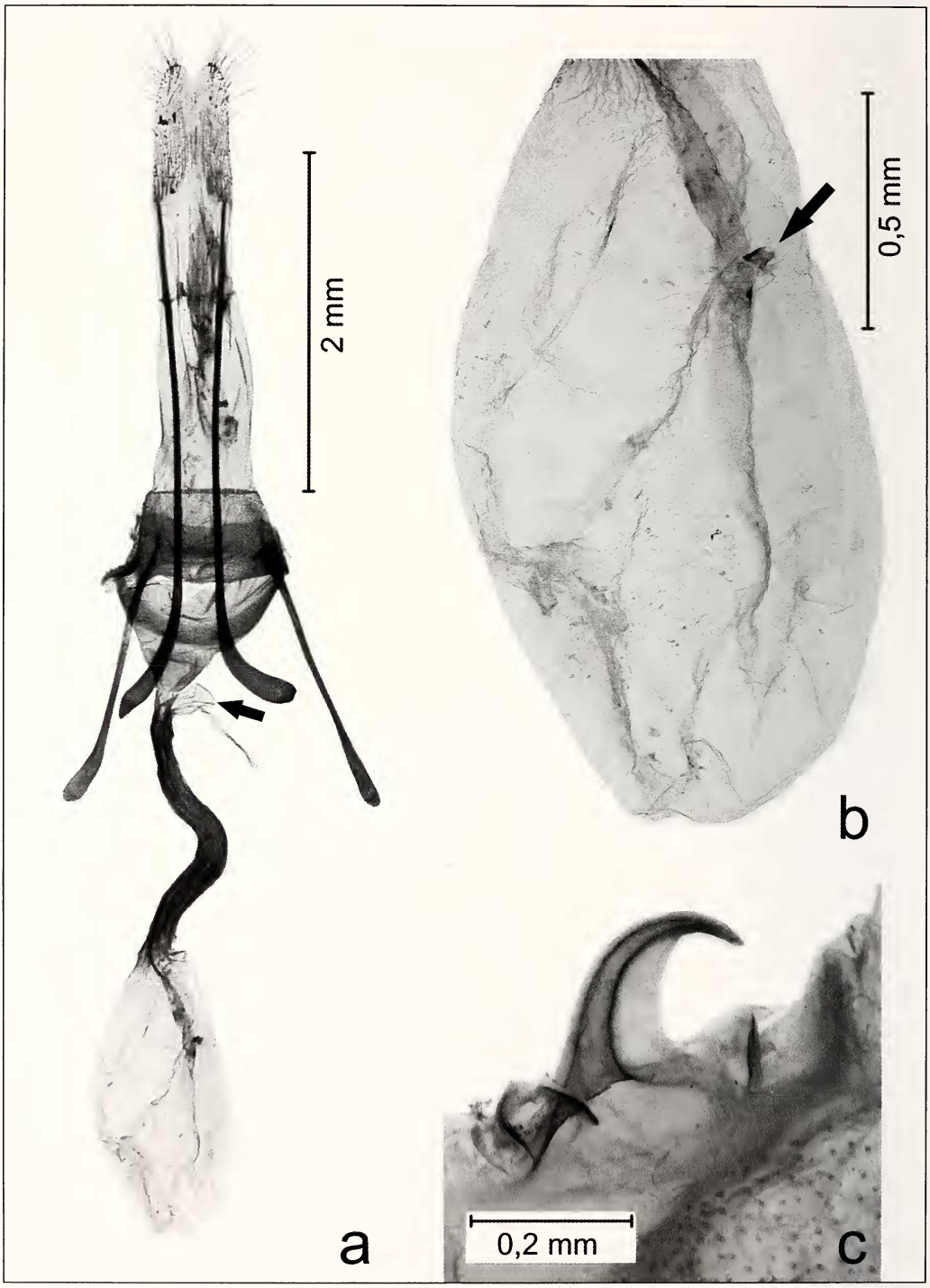

Fig. 2. Female genitalia and tympanal organ of *A. beschkovi*, **a.** female genitalia, with blind sac of the basal ductus seminalis (arrow), **b.** corpus bursae (stronger magnified), with small signum bursae (arrow), **c.** reduced left tympanal organ (slides: G-1307 (genitalia), G-1283 (tympanal organ), SMNK).

Fig. 3. Larvae and live male adult of *A. beschkovi* from W-Iran, 2004-2005, leg. M. Tavakoli, **a.** grey-greenish form of the larva, **b.** grey-brown form of the larva, **c.** resting specimen of a male *A. beschkovi*. Differences in colouration between the specimen shown above and the specimen shown in Fig. 4 are due to artificial light photography.

bursae). Ductus seminalis entering ductus bursae at the border between the funnel shaped and the stronger sclerotized part of the ductus bursae. The basal part of ductus seminalis bears a blind sac (Fig. 2a, arrow). Corpus bursae membranous and hyaline, approximately as long as the curved part of ductus bursae, oval shaped, with only one small signum in the posterior part of corpus bursae (Fig. 2a, b, arrow). The signum bursae varies considerably in shape. In one case it can be described as a pyramidal structure the tip of which is projecting into the lumen of corpus bursae.

Diagnosis. Apart from the characteristic habitus (Fig. 1a, c), the long setae on the antennae can serve as a diagnostic character of the females of *A. beschkovi*. The related species *A. marginaria*, *A. bajaria*, *A. leucophaearia* and *A. aurantiaria* lack these long setae.

The morphology of the female genitalia organ of *A. beschkovi* is clearly different from those of the females of the other investigated species (see Fig. 6). Apart from the unmistakable overall shape (compare Figs. 2a, 6a–d) there are several morphological character states which allow an easy identification of *A. beschkovi*. The crescent-

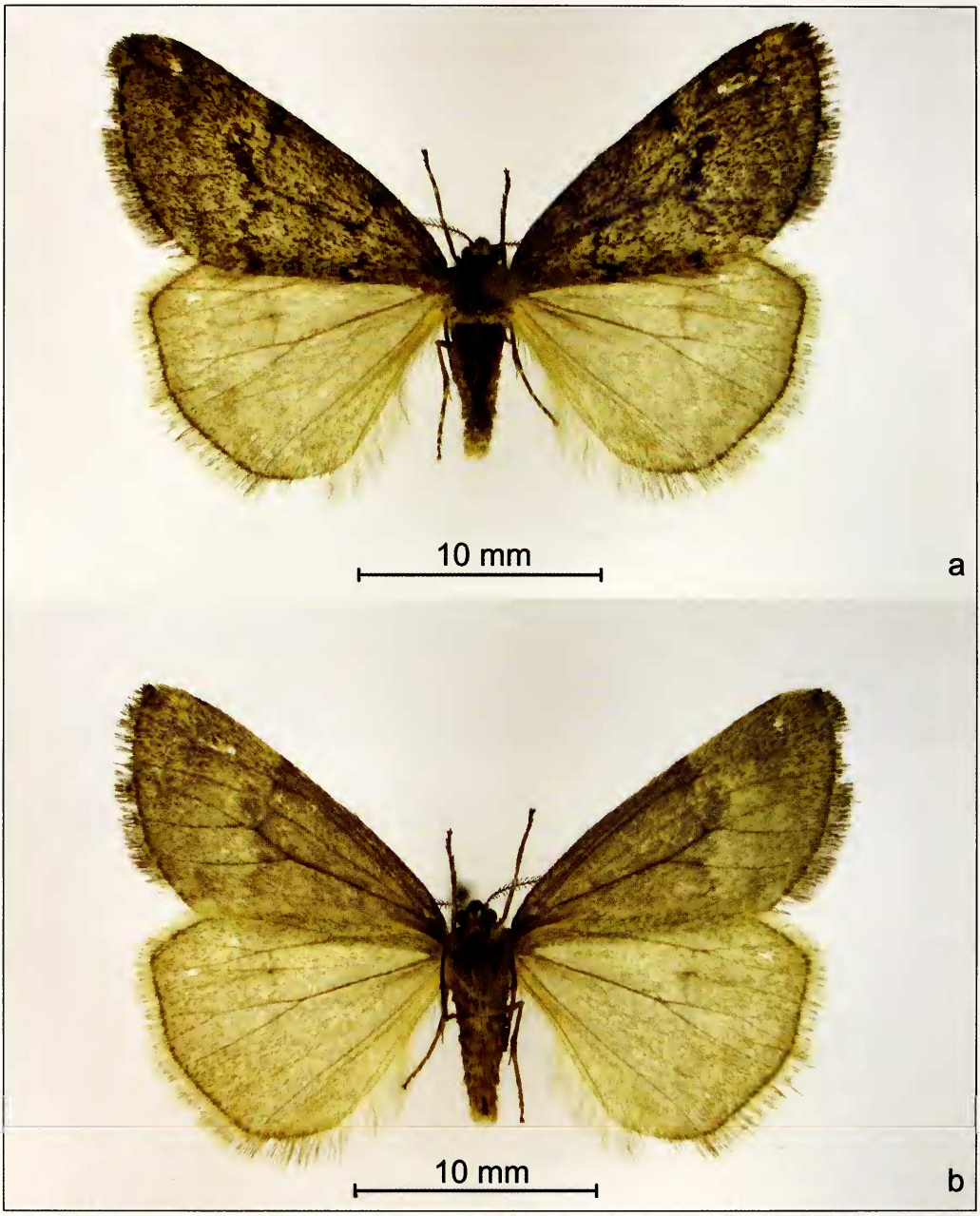

Fig. 4. Males of *A. beschkovi* from W-Iran, 2004-2005, ex larva, leg. M. Tavakoli, **a.** upperside, **b.** underside.

shaped lamella antevaginalis is unique to *A. beschkovi* within the investigated species. Furthermore the strongly curved (hockey-stick-shaped) apophyses posteriores and the curved, long anterior part of ductus bursae are characteristic.

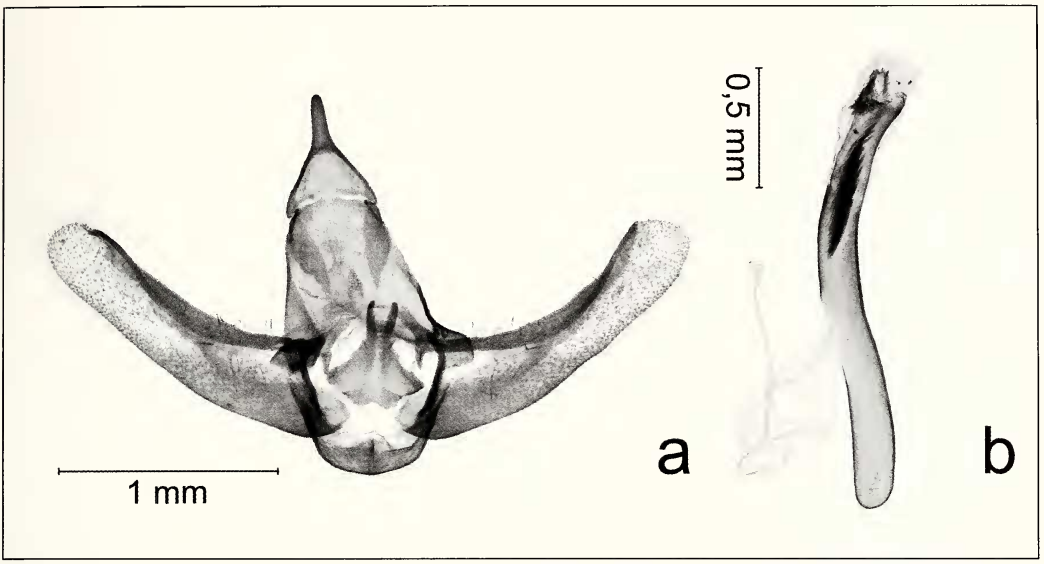

Fig. 5. Male genitalia organs of *A. beschkovi*, **a.** genitalia, **b.** aedeagus (gen. prep. G-1328, SMNK).

Life history. The formerly unknown larvae of *A. beschkovi* are presented in Figs. 3a–b. One form has a grey-greenish (Fig. 3a) another has a grey-brown habitus (Fig. 3b). The larvae feed exclusively on trees and shrubs of *Quercus brantii* and *Quercus infectoria* (Fagaceae). They are active at night and show reduced activity during daytime. The larval period spans about 55–65 days under laboratory conditions. In nature, larvae hatch from early March to early April, depending on the weather conditions. They are found until mid-May. Observed parasites are Hymenoptera (Ichneumonidae) and fungi. The adults occur in December and January in the forests. In Iran, *A. beschkovi* causes calamities with economic importance due to the defoliation of oaks by larvae. The species inhabits subtropical oak forests with an average altitude of 1.100 to 1.750 m above sea-level and snow in the winter. The mean annual temperature is about 15–20 °C and the mean annual precipitation is estimated at 450–650 mm. *A. beschkovi* is a dominant species compared with other oak-feeding moth species occurring in these habitats (*Catocala* spp., *Dicycla oo, Malacosoma* sp., *Porthesia melania*, *Tortrix viridana* and others).

Discussion

Wing reduction in female winter moths is a well known phenomenon (cf. Sattler 1991). The females of all *Agriopis* species are wingless (concerning *A. dira*, cf. Inoue et al. 1982). So it is not surprising that the female of *A. beschkovi* is wingless, too. Another interesting feature of winter moths is the usual reduction of mouthparts (Sattler 1991) which is also the case in *A. beschkovi* females as well as in the males. The reduction of the tympanal organs is observed in a considerable number of wing-reduced females of geometrid moths. In the species formerly included into the genus *Hibernia* (*Agriopis*

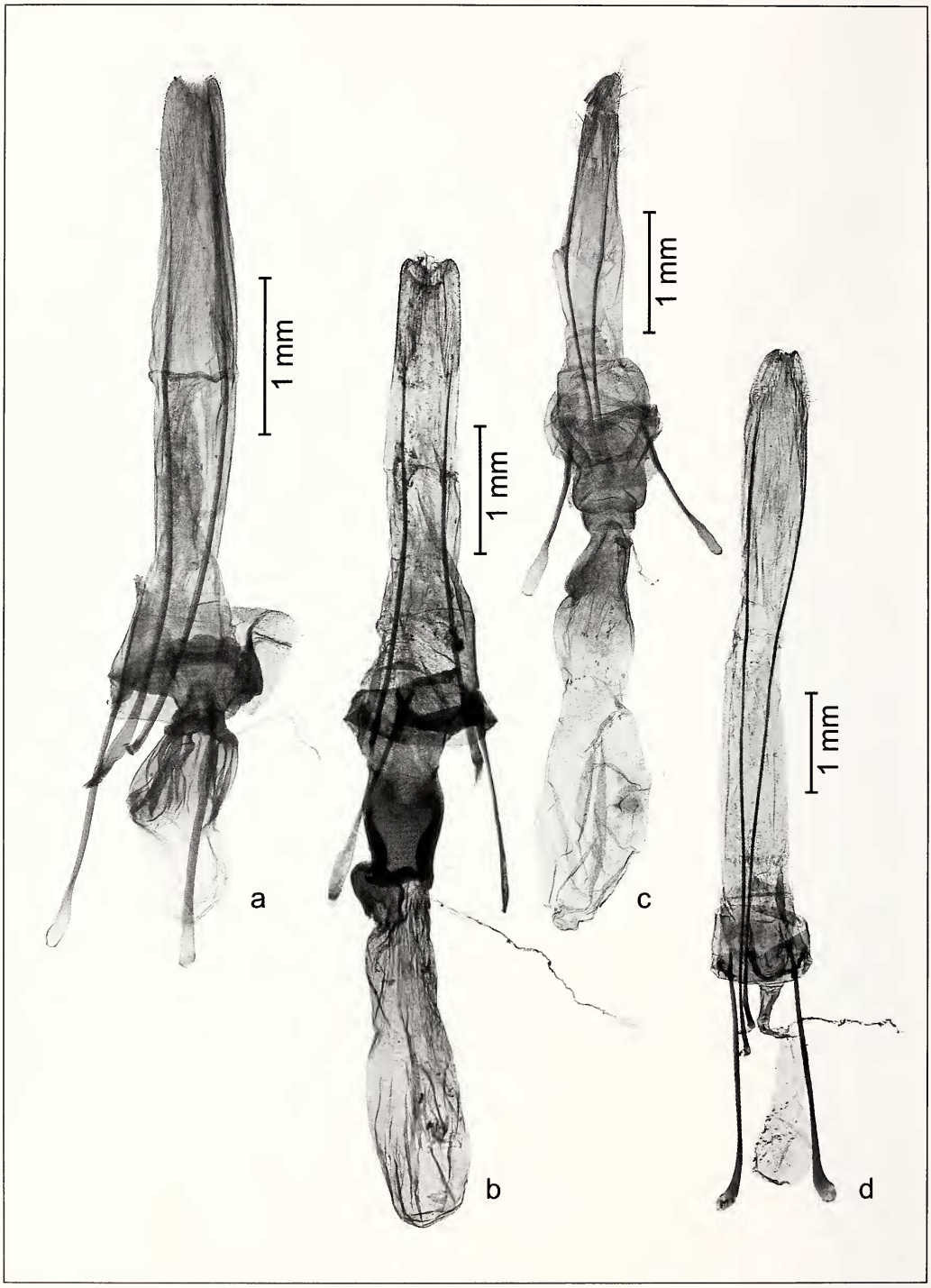

Fig. 6. Female genitalia of *Agriopis* species, **a.** *A. leucophaearia,* Austria (gen. prep. G-1339, SMNK), **b.** *A. aurantiaria*, Germany (gen. prep. G-1402, SMNK); **c.** *A. marginaria*, Austria (gen. prep. G-1398, SMNK), **d.** *A. bajaria*, Germany (gen. prep. G-1403, SMNK).

marginaria, Agriopis bajaria, Agriopis leucophaearia, Theria rupicapraria, Erannis defoliaria) male tympanal organs are well developed whereas those of the females are reduced (Heitmann 1954). This applies also to *A. beschkovi*. In reduction of wings and tympanal organs the females of *A. beschkovi* match the characteristics of other *Agriopis* females.

An interesting feature of the female genitalia of *A. beschkovi* is the blind sac at the basal part of the ductus seminalis which is also present in the female genitalia of *A. marginaria*. In *A. leucophaearia* the structure could not be observed. The blind sac seems also to be absent in the remaining two species *A. aurantiaria* (in three of the four investigated specimens the blind sac was absent, in one case the ductus seminalis was ruptured during dissection) and *A. bajaria* (two of four investigated specimens did not possess a blind sac; in the other two specimens it was not possible to decide whether a blind sac is present or not due to the poor quality of the material). However, further study is needed to examine if this character is really homologous in *A. beschkovi* and *A. marginaria*.

Acknowledgements

We are greatly indebted to Christiana Klingenberg and Alexander Riedel (both Karlsruhe) for their valuable help with photography and image processing and Axel Steiner (Wöschbach) who revised our English. Furthermore we would like to thank N. Pöll (Bad Ischl) and an anonymous referee for valuable comments.

Literature

Ganev, J. 1987. Eine neue Geometriden-Art aus Bulgarien *Agriopis beschkovi* sp.n. (Lepidoptera, Geometridae, Boarmiinae). – Entomofauna **8** (18): 273–275.

Heitmann, H. 1954. Die Tympanalorgane flugunfähiger Lepidopteren und die Korrelation in der Ausbildung der Flügel und der Tympanalorgane. – Zoologische Jahrbücher (Anatomie) **59**: 135–200.

Inoue, H., S. Sugi, H. Kuroko, S. Moriuti & A. Kawabe 1982. Moths of Japan, Vol. 2. pp. 1–552. – The Kyodo Printing Co. Ltd., Tokyo.

Müller, B. 1996. Geometridae. Pp. 218–249. – *In*: O. Karsholt & J. Razowski (eds.), The Lepidoptera of Europe. A distributional checklist. – Apollo Books, Stenstrup.

Sattler, K. 1991. A review of wing reduction in Lepidoptera. – Bulletin of the British Museum (Natural History) Entomology **60** (2): 243–288.

Scoble, M. J. (ed.) 1999. Geometrid moths of the world – a catalogue, 2 vols. – Apollo Books, Stenstrup. 1016+129 pp.